

Washington State Department of Transportation

Snow and Ice Plan



November 2004

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Snow and Ice Plan
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SECTION 1
2004-2005
ROADWAY TREATMENT GOALS

Section 1

2004-2005 Roadway Treatment Goals

A “goal” is a desired end product. It is fixed and independent of resources, weather and methods.

Actual “performance” varies based on all the occurring factors.

Due to the dynamic nature of winter weather and resultant road condition variations, WSDOT maintenance personnel will use a variety of treatments to control snow and ice at different times in different places. Results of snow and ice control treatments will vary dependant on a number of factors including severity and type of winter weather, program funding levels, geography, traffic levels, traffic speeds, and support facilities (i.e. liquid chemical storage tanks). While results can be measured in a variety of ways, the motoring public most often gages maintenance efforts in terms of road conditions during and immediately after inclement weather.





Maintenance personnel rate roadway conditions during the winter season (see performance measure chapter). This information can be used to project expected road conditions associated with different snow and ice treatment levels. The variable and unique nature of individual winter weather events limits the relevance of projected expectations on a per-storm basis. However, when ratings from an entire winter season’s storm events are averaged, this becomes a good indicator of the Level of Service (LOS) provided by maintenance for the winter season.

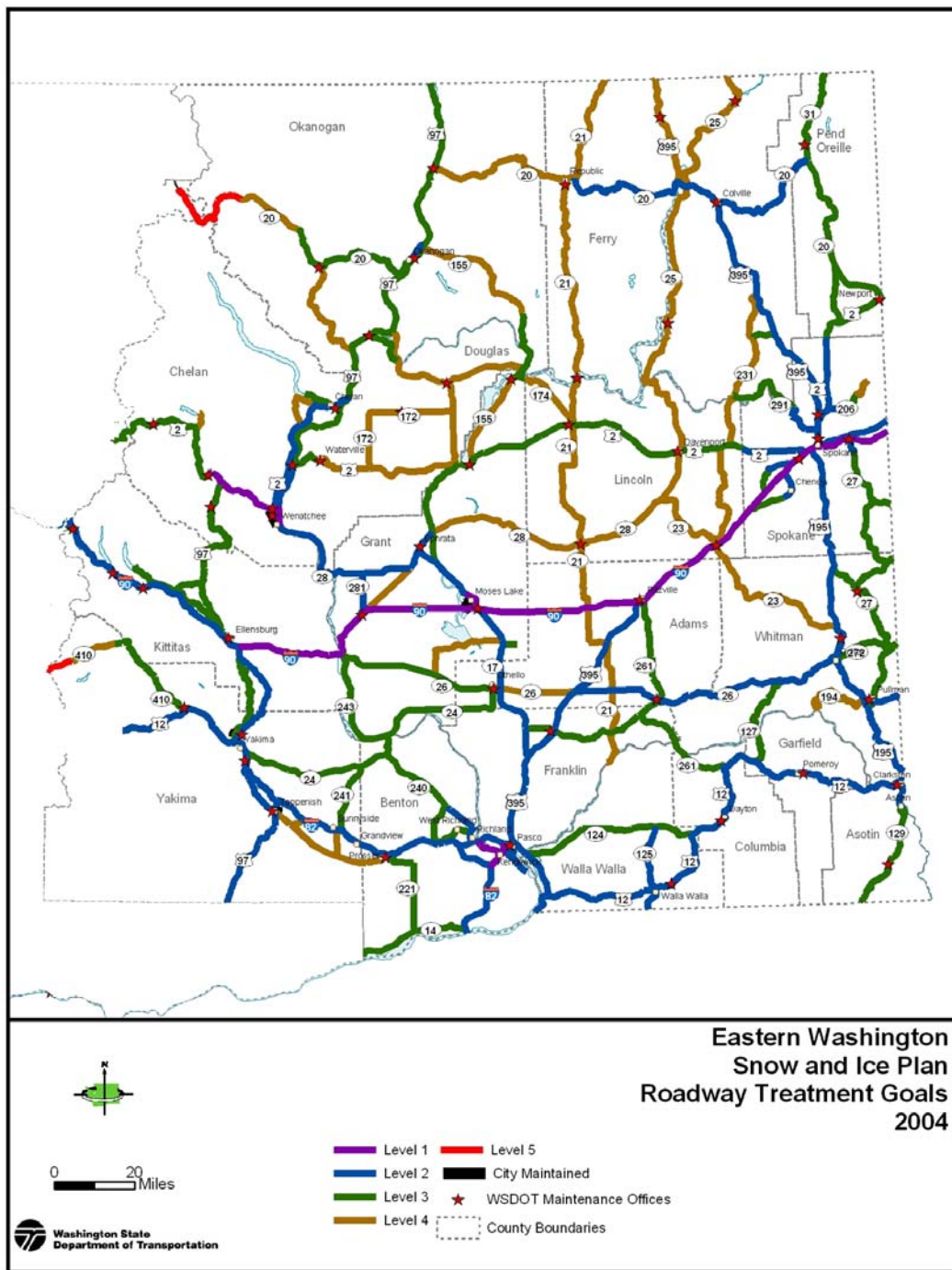
Due to the inherent differences in winter climate between Eastern and Western Washington, two different sets of road treatment levels are established in this plan for each half of the state. As limited funding requires prioritization of different roads for snow and ice control services, different treatments will be employed for individual roads and sections of roads.

Eastern Washington Treatment Goals: In Eastern Washington, the winter season is typified by periodic snowfall events, freezing temperatures for the duration of the winter season, and generally drier conditions. This drives the maintenance approaches of more extensive anti-icing (because there's less precipitation in the form of rain to wash it away), and more snow removal. The winter maintenance program (labor, equipment, and materials) is sized and developed to facilitate the movement and safety of traffic under normal expected winter conditions. The exceptional winter weather event in Eastern Washington is typically going to be a severe, wide spread ice storm or a snowstorm of very severe intensity, duration, and expanse. Since this happens infrequently, it would be an inefficient management of resources to size and base a winter maintenance program for this type of exceptional winter weather event; there would be an excess of equipment and workforce sitting idle for most of the winter season. The WSDOT program is based on history and the expected average conditions of winter for Eastern Washington. Therefore, when the rare, extremely severe winter weather occurs, the program is

unable to respond to the accustomed level due to a "shortage" of resources. The short-term consequences of this scenario would be far outweighed by consequences of wasted resources if the program were sized and based on the worst scenario.





For the purpose of this snow and ice plan, "Bare Pavement" is defined as a wet pavement surface free of most, but occasionally not all ice, slush, or snow. After snowplows clear snow from a travel lane, some of the surface area of a travel lane may have scattered remnants of ice, snow, or slush still present. This will still be considered a "Bare Pavement" condition.

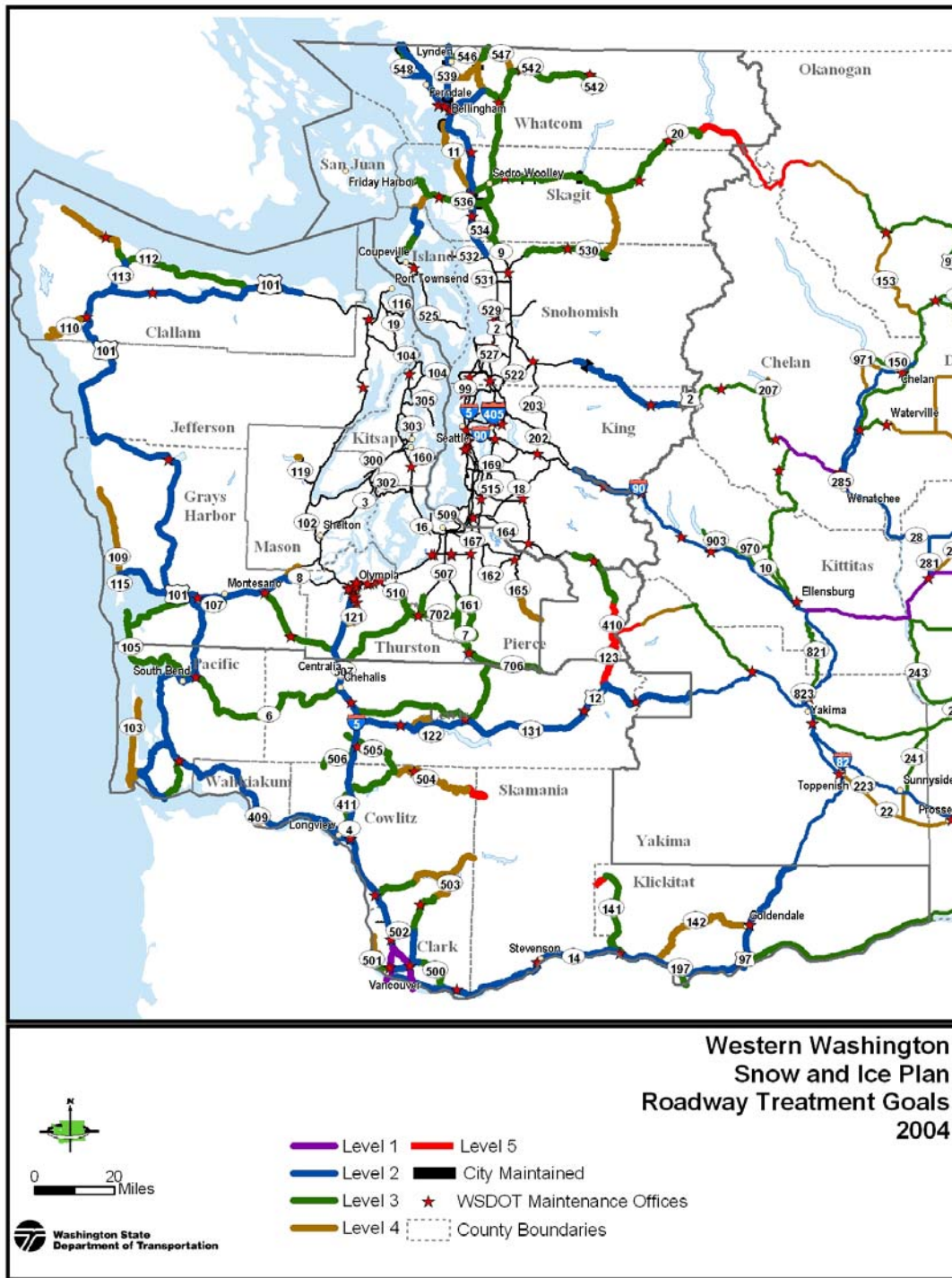
Treatment Levels	Eastern Washington Description of Roadway Treatment Actions	Expected LOS for season	Expected Road Condition after Treatments Completed
Level 1	<ol style="list-style-type: none"> 1. Pretreat as conditions allow with anti-icing chemicals before a forecast snow, black ice, or frost event. 2. Aggressively apply anti-icing chemicals to roadway if snow is accumulating to try to keep snow from compacting and bonding to pavement. 3. If compact snow and ice or heavy black ice forms on the roadway, apply pre-wet solid chemicals to the surface to try to break up the snow/ice for removal. 	A to B	 <p>Snow or ice buildup encountered rarely. Bare pavement attained as soon as possible. Travel delays rarely experienced.</p>
Level 2	<ol style="list-style-type: none"> 1. Pretreat as conditions allow with anti-icing chemicals before a forecast snow, black ice, or frost event. 2. Limited applications of anti-icing chemicals to roadway if snow is accumulating to try to minimize snow compacting and bonding to pavement. 3. If compact snow and ice or heavy black ice forms on the roadway, apply combination of sand and chemicals to try to provide traction and assist in the breakup and removal of snow/ice. 	B to C	 <p>Snow or ice buildup encountered at times but infrequently. Travel at times may experience some isolated delays with roads having patches of black ice, slush, or packed snow.</p>
Level 3	<ol style="list-style-type: none"> 1. Pretreat as conditions allow with anti-icing chemicals before a forecast snow, black ice, or frost event. 2. If snow accumulates, plow without the use of solid chemicals. 3. Sand compact snow and ice with limited use of chemicals. 	C to D	 <p>Snow or ice buildup encountered regularly. Travel likely to experience some delays with roads having black ice or packed snow with only the wheel track bare.</p>
Level 4	<ol style="list-style-type: none"> 1. Enhance traction with plowing and sanding. 	D to F	 <p>Compact snow buildup encountered regularly. Traveler will experience delays and slow travel.</p>
Level 5	<ol style="list-style-type: none"> 1. Limited snow and ice removal effort. 2. Road will remain passable as conditions allow. 3. Road closed when conditions dictate. 	N/A	Closed periodically or for the duration of the winter season.

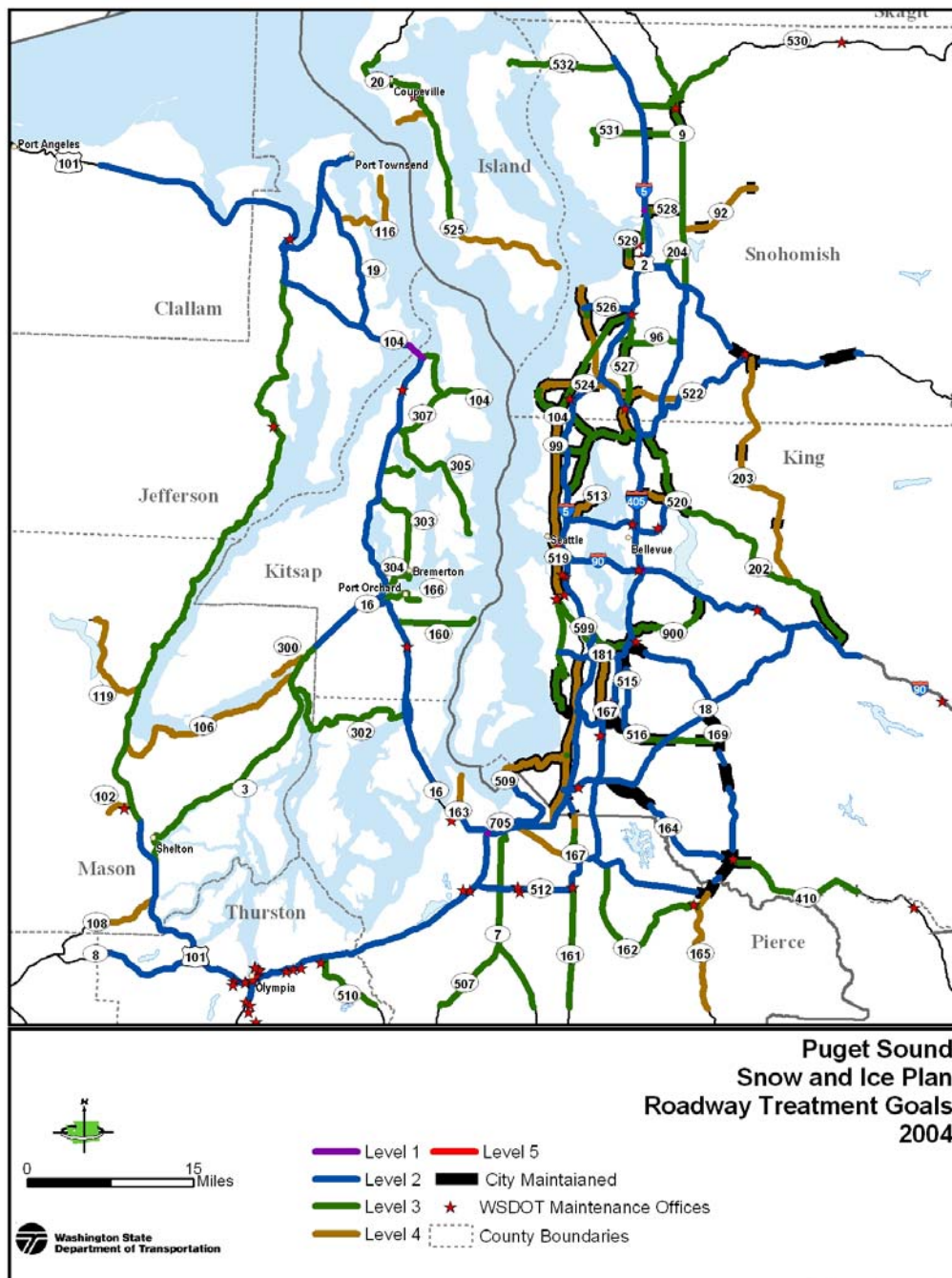


Western Washington Treatment Goals: In Western Washington, diverse microclimates are numerous. Typically the winter season lasts from mid to late November thru early March. The weather is generally wet with cool, moderate and occasional icy events. The winter maintenance program (labor, equipment, and materials) is sized and based to facilitate the movement and safety of traffic under normal expected winter conditions. This will typically be when temperatures drop and create black ice or frost conditions. A light to moderate snowfall event may also occasionally take place. These are typically characterized by localized events. The exceptional winter weather event in Western Washington is going to be a heavy snowstorm, short in duration over a wide geographic area. Since this happens very infrequently, it would be an inefficient management of resources to size and base a winter maintenance program for this type of exceptional winter weather event; there would be an excess of equipment and workforce sitting idle for most of the winter season. The WSDOT program is based on history and the expected average conditions of winter for Western Washington. Therefore, when the rare, heavy snow storm occurs, the program is unable to respond to the accustomed level of service due to a "shortage" of resources and gridlock caused by heavy traffic volumes in the urban areas. The short term consequences of this scenario would be far outweighed by consequences of wasted resources if the program were sized and based on the worst scenario that could possibly happen.

For the purpose of this snow and ice plan, "Bare Pavement" is going to be a wet pavement surface free of most, but occasionally not all ice, slush, or snow. After snowplows clear snow from a travel lane, some of the surface area of a travel lane may have scattered remnants of ice, snow, or slush still present. This will still be considered a "Bare Pavement" condition.

Treatment Levels	Western Washington Description of Roadway Treatment Actions	Expected LOS for season	Expected Road Condition after Treatments Completed
Level 1	<ol style="list-style-type: none"> 1. Pretreat roadway emphasis areas as conditions allow with anti-icing chemicals before a forecast snow, black ice, or frost event. 2. Aggressively apply anti-icing chemicals to roadway if snow is accumulating to try to keep snow from compacting and bonding to pavement. 3. If compact snow and ice or heavy black ice forms on the roadway, apply pre-wet solid chemicals to the surface to try to break up the snow/ice for removal. 	A to B	 <p>Snow or ice buildup encountered rarely. Bare pavement attained as soon as possible. Travel delays rarely experienced.</p>
Level 2	<ol style="list-style-type: none"> 1. Pretreat roadway emphasis areas as conditions allow with anti-icing chemicals before a forecast snow, black ice, or frost event. 2. Limited applications of anti-icing chemicals to roadway if snow is accumulating to try to minimize snow compacting and bonding to pavement. 3. During and after a snow event, try to provide traction with plowing and a combination of sand and chemicals until compact snow and ice surface can be removed. 	B to C	 <p>Snow or ice buildup encountered at times but infrequently. Travel at times may experience some isolated delays with roads having patches of black ice, slush, or packed snow.</p>
Level 3	<ol style="list-style-type: none"> 1. Pretreat roadway emphasis areas as conditions allow with anti-icing chemicals before a forecast snow, black ice, or frost event. 2. If snow accumulates, plow without the use of solid chemicals. 3. Sand compact snow and ice with limited use of chemicals. 	C to D	 <p>Snow or ice buildup encountered regularly. Travel likely to experience some delays with roads having black ice or packed snow with only the wheel track bare.</p>
Level 4	<ol style="list-style-type: none"> 1. Plowing and sanding. 	D to F	 <p>Compact snow buildup encountered regularly. Traveler will experience delays and slow travel.</p>
Level 5	<ol style="list-style-type: none"> 1. Limited snow and ice removal effort. 2. Road will remain passable as conditions allow. 3. Road closed when conditions dictate. 	N/A	Closed periodically or for the duration of the winter season.





Section 2

Training

Section 2

Training

Considering the increasing complexity of snow and ice control, the significant level of maintenance funds spent on this activity, and the importance of this activity to highway users, training WSDOT personnel on snow and ice control issues is a high priority. The current snow and ice training program consists of the following:

Annual Review of Snow and Ice Procedures

This training replaces the “blue book” and Snow and Ice Control Video. The training will be accomplished by area or crew meetings held annually each fall. A course code has been developed for this seminar

Included will be:

- A cover letter asking that supervisors/lead techs go over the items in the list.
- The checklist of procedures.
- An ATMS roster.

This crew or area meeting should take place before winter and include all field personnel – permanent and temporary. Supervisor/lead techs should check each item reviewed during the meeting. They should have employees sign or initial the ATMS roster for the review and return the checklist and roster to the Region Maintenance Training Coordinator (RMTC).

It is anticipated that this review/training will vary from region to region or even area to area. In some areas it could take most or all of one day. In others it may take only a few hours. If loader and salt/sand pile locations is included, it could continue into a second day.

On the Job Training

This is done routinely especially with temporary or new employees. The tracking and characterization of this training is being developed.

Wing Plow Training

This training program consists of classroom and hands-on operational training, provided by Region training staff. The wing plow operational guidelines are included in this section. All employees who will be operating a wing plow must complete this training.

Snow Camp

This two or three day workshop is designed specifically to east and west side winter conditions. Two Snow Camps (one East and one West) were held in Fall 2004. The emphasis is for

employees to network with each other across regional boundaries, share ideas and learn about the latest technology and procedures in winter operations. Individual regions can determine target attendees. However, seminar size is limited to 60 – 90 techs so Tech III's and Lead Techs may be the ideal audience so that these individuals rotate through the Camp every two to three years.

A course code has been developed for this seminar. Teams of RMTTC's sponsor this event annually.

Computer Based Individual or Small Group Training

This training is in the development process. It should be ready to implement in 2005. Length of this training averages 40 hours.

Snow College

This is a comprehensive 3 to 5 day interactive course presented by consultants or University staff. Targeted attendees are maintenance supervisors.

Advanced Training

Regions or areas can undertake this training as appropriate to their local needs. Topics can be chosen individually. This could be ½ day to a full day meeting.

Topics include:

- Decision making guidelines about product use under various road conditions.
- Advanced RWIS, ARROWS, storm prediction and other forecasting tools.
- The role of the TMC.
- Budget impacts of winter operations.
- Collecting data from the state winter operations database.
- Management expectations of procedures, performance, etc.
- Liability issues.
- Stockpile inventories. (Office Managers & Fiscal Techs)
- Employing winter temporaries. (Office Managers & Fiscal Techs)
- Taking calls from the public and communicating with TMC. (Office Managers & Fiscal Techs)

Regional employees, as well as individuals from HQ, that can be invited as expert speakers on many of these topics.

Trips to other states and/or winter conferences can be a great opportunity for the agency to gain and share knowledge from the work of others. Area superintendents are the appropriate audience.



ANNUAL REVIEW OF SNOW AND ICE PROCEDURES

Coordination

- ☐ 1) Radio procedures
 - a) Road and Weather Reports
 - b) Reporting Accidents
 - c) Etiquette
- ☐ 2) Plow routes and responsibilities
 - a) Who's doing what and where
- ☐ 3) WSP call out procedures/priority system
 - a) Responding to accidents and incidents
- ☐ 4) City and State responsibilities
 - a) Snow removal
 - b) How to plow within city jurisdiction (where to put snow)

Safety

- ☐ 1) Safety equipment
 - a) Personal Protective Equipment
- ☐ 2) Injury procedures
 - a) Reporting personal accidents

Policies and Directives

- ☐ 1) Maps
 - a) Level of service
 - b) Roadway condition goals
 - c) Roadway priorities
- ☐ 2) Sanding policies
 - a) When and where to use abrasives
 - b) Spinner shut on and off
- ☐ 3) Chemical application
 - a) Timing of applications (humidity and temp.)
- ☐ 4) Procedures for stranded motorists
 - a) Towing policy
 - b) Calling for help
 - c) Transporting passengers
- ☐ 5) Media policies
 - a) Talking to the media
- ☐ 6) Public relations
 - a) Talking to the public (why we do what we do)
- ☐ 7) Mail box replacement
 - a) Criteria for replacement
- ☐ 8) Winter scheduling including contingency
 - a) Call out procedures
 - b) Shift assignments

Chemical Applications

- ☐ 1) Chemicals currently being used
 - a) How do they work
 - b) When to apply
 - c) When to reapply or not
 - d) Rates
 - e) Timing
 - f) Application areas
 - g) Areas of priority
 - h) Using prewet
 - i) MSDS info

Equipment

- ☐ 1) Plowing
 - a) Techniques
 - b) Timing
- ☐ 2) Wing plow
 - a) Policies
 - b) Procedures
- ☐ 3) Chemical application techniques
 - a) Solid
 - b) Liquid
- ☐ 4) Calibration of equipment
 - a) Abrasives
 - b) Liquid
- ☐ 5) Procedures for Installations
 - a) Plows
 - b) Other attachments
- ☐ 6) Loaders
 - a) Operations
- ☐ 7) Equipment procedures
 - a) Reporting deficiencies
 - b) After hour breakdowns

Record Keeping

- ☐ 1) PDA
 - a) Refresher on use
- ☐ 2) Inventory procedures
 - a) Tracking
- ☐ 3) Snow and Ice database
 - a) Application records
- ☐ 4) After Action Reports
 - a) Documenting what works and where

Weather

- ☐ 1) Weather resources
 - a) List weather sources
 - b) RWIS and ARROWS refresher

Environmental

- ☐
 - a) Review BMP's
 - b) Application locations (Fish Sticks)
 - c) Stockpile management (containment)
 - d) Other

Supervisor Signature

Date

Wing Plow Operational Guidelines

Pre- Operational Check List:

1. **Inspect** components for the following:
 - Plow and plow frames for cracks, broken welds or loose bolts. Safety chains and bits for wear and general condition.
 - Plow pins for washers and cotter pins.
 - Hydraulic lines, fittings, and cylinders for damage or leaks.
 - Safety chain security for transporting.
 - Tower slide lubrication.
 - Bolts and push beam anchor bolts, lift cable for fraying and proper tension.
 - Rear mounting plate and wing brace vertical supports for bends, loose bolts or cracks.
 - Wing extension push arms adjustment. These should accommodate road width.
 - Controls for smooth and correct operation.
2. **Repair or replace** any items found to be deficient. Be sure to know what size wing is on your truck.
3. **Check** the condition of the plows periodically during the shift and inspect at shift end.

Lowering the Wing

1. Be certain area is clear and the safety chain is removed.
2. Set toe (leading edge) to approximately 6 inches above the pavement.
3. Lower the heel (trailing edge) to approximately 6 inches above the pavement.
4. Lower the wing evenly to the pavement and allow a small amount of float at the float link.

Raising the wing

1. In an urgent or emergency situation use the wing lift switch on the joy stick, or manually raise the toe and heel until the wing is fully raised.
2. Raising and lowering may be performed with the vehicle in motion.

3. When approaching railroad crossings, slow down and raise the wing so as not to hook into tracks.
4. Slack in the tower cable will cause a delay when raising the wing.

Safe Operating Practices

1. The Supervisor of the area should develop a site-specific plan for wing plow operation (“Wing Caution Zones.”). There are obstacles. Know where they are.
2. Important: Refrain from unhooking the safety chain on the wing until the engine has been started and the hydraulics on the wing pressurized, because the cylinder may not support the wing until charged.
3. Do not operate a plow unless you are qualified, trained and understand how to operate the vehicle and the controls.
4. An operator not qualified to operate a wing plow can operate the truck and front plow as long as the wing is safety chained and not used.
5. Adjust your plowing speed to the conditions, e.g. obstacles, traffic volumes, pedestrians, highway conditions, grade, terrain and visibility.
6. Use caution when plowing around obstacles. If in doubt raise the wing.
7. When roadway features are too narrow to accommodate the use of the wing without lane changes, raise the wing plow.
8. Do not use the wing in weather conditions where visibility is adversely affected, such as heavy fog or whiteout conditions.
9. It is not recommended you wing on soft surfaces such as gravel shoulders. If you do wing on soft surfaces, do so only after slowing to a safe speed and adjusting the wing lift to prevent the wing from penetrating the soft shoulder material. (Float link adjustment)
10. Do not use the wing plow to widen out shoulders. The operator cannot see the plow tip well enough to make the fine adjustments necessary to perform this job safely.
11. Do not use the wing if traffic or highway conditions are not suitable for safe operation.
12. When using the wing plow, remain constantly alert to traffic and roadside obstacles.
13. It is recommended to carry ballast and use tire chains if needed when using the wing plow.
14. Do not park or leave the unit without either securing the safety chain if the wing is up, or lowering the wing to the ground.
15. Slowing down and downshifting instead of raising the wing will help maintain your plow pattern and reduce the time to clear the travel way.

16. When plowing alone with the wing plow, use the front plow and the wing plow in the same direction. Plow only the right lane and the shoulder. Do not use as a “V” plow.
17. When plowing in tandem in multi-lane areas with median snow storage, it is recommended that at least one truck plow to the left a few hundred feet in front of the wing unit. This plow pattern provides a clear path left of the wing truck for motorist inclined to pass.
18. When gang plowing (3 or more trucks), position the wing plow unit where the wing can be buffered or protected by one of the other plow trucks in the formation. Regional direction will dictate whether or not the wing may be used in the center or left lanes. Check with your supervisor for proper guidance.
19. Safety chains are not designed to keep the wing tight against the side of the vehicle. Wings can move out even with safety chains properly attached. This is especially true on ten-wheelers.
20. When storm conditions so impair visibility that the centerline is difficult to find, discontinue use of the wing plow.
21. Do not rub guardrail with the wing. The leverage exerted on the wing can turn the truck toward the rail. Be aware that when the wing is in the up position, it still extends past the edge of the front plow and can strike obstacles that the front plow will clear. Check rear support arm for breakaway bolts.
22. Use a block to prevent accidentally raising the wing whenever the truck or plow is being worked on.
23. When mapping wing plow caution zones, don't forget to include expansion joints on bridges. Check plow angle vs. joint angle.

SECTION 3

Maintenance Manual Updates Related to Snow & Ice Control



January 20, 2005

TO: Maintenance Engineers/Superintendents

FROM: Chris Christopher, State Maintenance Engineer

RE: Conditioning Winter Abrasives Stockpiles to Prevent Freeze-up
(This policy language will be incorporated into chapter 7 of the WSDOT
Maintenance Manual)

The following is provided to establish Washington State Department of Transportation (WSDOT) policy on mixing snow and ice control chemicals into stockpiles of abrasives that are used for roadway traction. This practice, commonly known as conditioning, is done to prevent the stockpiles from freezing.

Snow and ice control chemicals should be mixed into winter abrasives stockpiles only at locations where cold winter weather would typically freeze an un-conditioned stockpile.

When abrasives stockpiles are conditioned, either rock salt or solid, corrosion-inhibited chemicals may be used for this purpose. No more than the minimum amount of chemicals needed to keep the abrasives stockpile workable should be used. In many locations around the state, this will be a ratio of 20:1 (twenty parts abrasives to one part chemical) by volume. In some areas with wetter climates, a stronger concentration, up to 10:1, is required to keep stockpiles from freezing.

At times, stockpiles are conditioned at a rate stronger than the minimum concentration needed to keep them workable so that ice-melting capabilities are added to the abrasives. This is generally viewed as a less-than-optimal approach to snow and ice control. The current belief is that straight chemicals should be used to melt snow or ice and that adding abrasives to this equation results in costs and adverse impacts that outweigh its benefits. However, if maintenance personnel are working with some unique circumstances where such a mixture provides the most cost-effective method for improved road conditions, they can mix and use stockpiles with stronger concentrations of anti-icing chemicals. In such cases of stockpiles being conditioned at a chemical concentration of stronger than 10:1, only corrosion-inhibited chemicals shall be used.

May 6, 2004

TO: Maintenance Engineers/Superintendents
THRU: Chris Christopher, State Maintenance Engineer
FROM: Greg Hansen, Winter Maintenance Specialist
SUBJECT: Revision to Maintenance Manual
Page 7-5 Spinner Shut Off

The guidelines shown below will supercede guidelines outlined in the March 2002 Maintenance Manual on page 7-5 "Spinner Shut-Off". The new title of that paragraph will become "Sanding Operations when Encountering Traffic".

Sanding Operations when Encountering Traffic. During sanding operations it will be the responsibility of the driver applying sand to make decisions regarding techniques to be used when in close proximity to traffic. Many variables can exist when encountering traffic, such as traffic volume and speed, roadway condition and weather. The driver will have the option of deciding which of the following actions to take, based on the circumstances that exist at the time.

Sanding operations involving oncoming traffic:

1. Taking road conditions into account, temporarily slow truck down to a minimum safe operating speed. Slowing truck speed will minimize the bouncing effect of sand hitting the roadway surface.
2. Turn down spinner to slowest setting that still allows sand to continue flowing without plugging chute or hopper.
3. Temporarily turn spinner off while allowing traffic to pass. Turning the spinner off and leaving the chain moving will still allow some sand to fall through the chute onto the road (assuming that the sand is not so wet that it will plug the chute).
4. When slowing spinner down or turning it off, it may be necessary to also slow down flight chain speed, preventing plugging of chute or hopper.
5. When encountering a limited number of vehicles and road conditions warrant skip sanding, temporarily shutting off the sanding operation (both spinner and flight chain) while oncoming traffic passes is acceptable.
6. Once oncoming traffic has passed, resume normal sanding operations.

To_Placeholder
Date_Placeholder
Page 2

Traffic Backups

1. During sanding operations allow backed up traffic to pass when possible. Take road and weather conditions in to account and pull over onto the shoulder or other safe area, stop the vehicle and sanding operation and let backed up traffic pass. Once backed up traffic has passed, resume normal sanding operations.

11-21-03

TO: Maintenance Engineers/ Superintendents

THRU: Chris Christopher

FROM: Greg Hansen

SUBJECT: Chemical Slipperiness

Because of the potential for slippery conditions to be caused by misapplication of liquid anti icing chemicals to pavement, the following guidance should be utilized:

Applying anti-icing chemicals and humidity

There is the potential for liquid anti icing chemicals to transform from liquid to solid and solid to liquid. This "slurry" phase takes place quickly and is short in duration. The greatest potential for a slipperiness problem is when temperatures are in the 40's and the relative humidity between 45% and 50%. Research shows the common denominator for most incidents investigated are temperatures between 40⁰ and 54⁰ degrees F (most often at 46⁰ F) and a relative humidity of approximately 45-50%. The slurry transition phase can also occur at relatively low humidity levels (below 35%). These conditions typically occur in the fall and generally involve an application of liquid anti-icing chemical prior to the first freezing event of the season. Therefore:

- 1) Users should not apply anti-icing liquids for a winter event if the air temperature is above 40 degrees with a relative humidity of 45 to 50 %. If these conditions exist, delay the application until temperatures drop.
- 2) If humidity is (or expected to drop) below 35%, application rates should be reduced. Using the WSDOT anti icing chemical application guideline chart, apply at the lowest recommended rate. The chart is located in the September 2003 WSDOT Snow and Ice Plan
- 3) Most occurrences of slipperiness involved an application made between noon and 3pm. If it is necessary to make an application around these times, temperature and humidity levels must be verified prior to applying.

To: Maintenance Engineers/ Superintendents
From: Greg Hansen
Chemical Slickness

Applying anti-icing chemical after an extended dry spell

When a liquid anti-icing application has been made after a long dry spell, the build up of oil-based residuals left from vehicles and the application of a liquid to the roadway can produce a slick surface. This is very similar to a light rain shower on a roadway surface after an extended dry spell. The chemicals used for anti icing are heavier than water may displace any petroleum-based residuals on the roadway surface. The chemical itself may not cause the slipperiness, but may be a contributing factor in a reduced friction surface.

- 1) Therefore users should be cautious when applying anti icing liquids after an extended dry spell. Using lower application rates may reduce the risk of slipperiness developing under these conditions. Using the anti icing chemical application guideline chart, located in the September 2003 WSDOT Snow and Ice Plan, apply at the lowest recommended rate.

Multiple applications

If anti icing liquid chemicals are being applied on multiple back-to-back applications, the application rate should be reduced on subsequent applications. Reducing the application rate will prevent excess buildup of chemical on the roadway. The rate should not be reduced if excess moisture or high traffic volumes have diluted the initial application.

If you have any questions or need help with an application rate, please contact Greg Hansen at 360-705-7862



December 5, 2003

TO: Maintenance Engineers/Superintendents

THRU: Chris Christopher, State Maintenance Engineer

FROM: Greg Hansen, Winter and Maintenance Specialist

SUBJECT: Field Testing and Sampling of Anti-Icing/Deicing Chemicals

The following is provided to maintain the accuracy and consistency of the anti-icing-deicing chemical testing and sampling program by field personnel. If there is a dispute with a chemical vendor, documentation of procedures is necessary for compliance with the current Chemical Contract.

When to take a chemical deicer sample

Take a one-gallon sample from every shipment of chemical deicer (solid and liquid) received. Store sample onsite for future testing in case of disputes with lab findings or to determine the extent of product failure. If lab failures start to occur, specific sites will be asked to send samples to the Headquarters Materials Lab from your stored samples taken at time of delivery.

When to send a chemical deicer sample to the Headquarters Materials Lab

In addition to the one-gallon sample taken and archived, send in a one-gallon sample to the Headquarters Materials Lab from each maintenance area from the first shipment received. For liquid samples it is recommended to use a plastic container with a small lid opening. Additional samples for submission to the lab will be taken from shipments received on a random basis. Maintenance areas will need to coordinate with their outlying sheds to determine who collects and sends a sample to the lab. Each area will decide what is the appropriate number of samples to collect based on an estimate of the total number of deliveries that might be received during the winter. A general guideline would be to collect and send a minimum of 3 test samples to the lab (beginning, middle and end of season). If lab failures occur, notification will be sent to all areas using that failed product. Additional lab testing will be done until the chemical meets specifications or the vendor is dropped from the contract for failing to meet specifications.

- 1) For the current contract, if a chemical has a total of 5 lab failures on a statewide basis, it will be dropped from the contract. It is critical that you send your lab sample as soon as possible. It takes a few days for the sample to get to the lab and one day of prep time and another three days for the actual test. Notification to the vendor that there is a problem needs to be done in a timely manner. This will be in written form by the Office of State Procurement. Disqualification can only be done after a vendor has been notified and has an opportunity to correct the problem.

Procedures Checklist

A copy of the Procedures Checklist needs to be kept at all locations receiving chemicals. The checklist may be needed in case of disputes with lab findings or to determine the extent of product failure. See Appendix 1

Field Inspection

Before allowing any product to be unloaded it is necessary to adhere to the following procedures:

1. Document and maintain records on all deliveries, including those that are rejected. This may include but not limited to the following.
 - a) Date of the order
 - b) Date and time of delivery
 - c) Verification of advance delivery notification
 - d) Delivery within allowable times
 - e) Name of delivery company and license plate numbers.
 - f) Product being delivered is what you ordered.
 - g) Document all significant procedures prior to unloading of product
 - h) All papers required of a delivery exist, are complete, and legible.
2. Visually inspect the load to determine if there are any obvious reasons why the load should be rejected.
3. Verify separation or non-separation of product.
4. No precipitate or flocculation (lumpy masses) in liquid products is allowed in excess of the specification limits. Material showing these or other uncharacteristic traits when delivered may be immediately rejected at the option of the person receiving the product or their supervisor. Any problems must be noted at the point of delivery. Notification must be relayed to the Regional Purchasing Officer for action.

Deicer Transmittal Form

Use this form to send in all samples to the Headquarters Materials Lab. A copy should be kept and archived. Deicer transmittal form is located in Appendix 2

Unloading

If all required information is in order and the product appears to be correct as ordered, document the amount of product currently in storage prior to unloading and begin the unloading process.

1. The delivery truck shall unload solid materials in a windrow, unless end-dump delivery vehicle was specified on the order.
2. For liquid products, the specific gravity or weight of a one-gallon sample needs to be checked prior to unloading, to verify compliance with the specification. If the delivery truck has the ability to circulate the load, do so for 5 minutes prior to taking the sample for specific gravity test. Specific gravity, weights and concentrations of products are in Appendix 3

3. Per the state contract the concentration can be off by plus or minus one percent. If your load is not within specs then you should take a second sample. If 2nd sample fails contact vendor and discuss rejecting the load. Specification guidelines are located in Appendix 3
4. When off loading tanker note which tank product will be pumped into. Document how many gallons of product in tank prior to and after pumping.
5. Visually inspect the delivered product again while unloading. If problems are noted that are a cause for rejection of the load immediately halt the unloading process. Take photos if applicable and record any pertinent information. Conduct the following procedures if the material is to be rejected
 - a) If there is a problem and reloading can't be done, (mixed with previous material) note the amount of product (liquid only) pumped into the tank and total product now present in the tank.
 - b) Circulate the tank and then pull two one-gallon (4-Liter) samples of the contaminated deicer material now in the tank.
 - c) Check and record the specific gravity of the samples.
 - d) Secure the product as needed to assure its integrity. Determine if all products on hand will have to be removed.
 - e) Send samples directly to Chief Chemist at the Headquarters Materials Laboratory.
 - f) Immediately advise the Regional Purchasing Officer of any ordering, delivery, storage, or product quality issues.

Sampling and Testing

After the shipment has passed the initial inspection and is approved for unloading, take two one-gallon samples of the liquid or dry product upon delivery. One sample will be used for testing and/or fingerprinting to verify product quality. The other sample will be kept on site for any future testing if necessary. Clearly label sample containers with product name and site location. Send a one-gallon sample directly to the Headquarters Material Testing Laboratory. When sending a sample to the lab, use the Deicer Transmittal Form found in Appendix 2

1. If the load is liquid, a one-gallon sample will be taken from the transfer hose in three equal parts. Each part will be mixed together with the other parts to make up the one-gallon sample that will be submitted to the laboratory for testing. The samples will be collected during unloading as the first third, the second third and the last third of the product that is being delivered. If the trailer or pup has compartments the three equal samples shall be taken from only one of the compartments to complete the sample. Check and record the specific gravity of the samples.
2. If the product is solid, the delivery truck will unload the solid material in a windrow, unless end-dump delivery vehicle was specified on the order. Samples of the windrow materials should be obtained from the complete cross section of the windrow. Portions of the sample will be taken from the top,

center, and bottom in proportion to the cross section area and well within the stack each time. It is best practice to cut completely through the stack because fine material sifts to the bottom. Care should be taken to obtain a complete and representative sample. The sample should be immediately placed into a wide mouth 1-gallon container with a screw top lid to avoid exposing the sample to atmospheric moisture.

Rejecting Loads

The level of authority to reject a load should be decided by each area before deliveries are made. If the decision is made to reject a load, it is advisable to call the vendor and the Region's Purchasing Officer before the load is sent back. A list of vendors and their phone numbers are in Appendix 3

Shipping

Containers sent to the Headquarters Materials Lab must be clean and free of leaks. They must be properly packaged and secured before shipment to prevent contamination and spillage. Deicer transmittal form must be included with material sample. See Appendix 2

Appendix 1: Procedures Checklist

Sampling Chemical Deicers

Testers Name _____ Date _____

Location _____

Procedures

Yes No

1. The tester has a copy of the current procedures on hand?

☐ ☐

2. Has material been circulated (if applicable)?

☐ ☐

3. Specific gravity or weight of product verified before unloading?

☐ ☐

4. Specific Gravity of Pre-Sample _____

First attempt: Pass ☐ Fail ☐ Second Attempt: Pass ☐ Fail ☐

5. Sample size meets agency requirements? (1 gallon min.)

☐ ☐

6. Location of tank or stockpile where the product is off loaded

7. Quantity of product in tank or stockpile prior to unloading?

8. Quantity of product in tank or stockpile after unloading?

9. Sample labeled as required?

☐ ☐

10. Send sample to Headquarters Materials Lab

☐ ☐

Send Samples via WSDOT courier
Sending by U. S Postal Service
Sending by Fed X or UPS

Mail Stop 47365
PO Box 47365 Olympia WA 98504
1655 South 2nd, Tumwater WA 98512

Signature of Tester _____

Comments:

Appendix 2: Deicer Transmittal Form

Contract # 06902/3639

HQ Lab #

Sampling Person _____

Date _____

Location _____

Region _____

Contact Person _____

Phone # _____

Chemical Deicers (Check One)

Ice Slicer Elite ☐

Clear Lane PNS ☐

Freeze Gard Zero ☐

Geomelt ☐

CMA ☐

Ice Stop CI2000 ☐

Other Product _____

1) Date of Order _____ Date of Delivery _____

2) Advance delivery notification Yes ☐ No ☐

3) Time of delivery acceptable Yes ☐ No ☐

4) Delivery Point _____

5) Shippers Name _____

6) Trucking Company _____ License Plate# _____

7) Quantity Delivered _____

8) Lot # of product delivered _____

9) Shipping Papers adequate Yes ☐ No ☐

10) Send sample to Headquarters Materials Lab

Samples via WSDOT Courier
Sending by U. S Postal Service
Sending by Fed X or UPS

Mail Stop 47365
PO Box 47365 Olympia WA 98504
1655 South 2nd, Tumwater WA 98512

Comments:

To: Maintenance Engineers/Superintendents
 Field Testing and Sampling of Anti-Icing/Deicing Chemicals

Appendix 3: Product Specifications

VENDOR	CONTACT PHONE #	CHEMICAL NAME	PRODUCT NAME	PERCENT CONCENTRATION	SPECIFIC GRAVITY SPECIFICATIONS	WEIGHT Specifications Lbs/Gallon
Dustbusters	800-550-4276	Magnesium Chloride	FreezeGard Zero	29%	Lower Limit 1.25	Lower Limit 10.5
					Upper Limit 1.30	Upper Limit 11.0
Road wise	253-761-2487	Magnesium Chloride	Ice Stop CI 2000	30%	Lower Limit 1.25	Lower Limit 10.5
					Upper Limit 1.30	Upper Limit 11.0
America West	888-547-5475	Calcium Chloride	GeoMelt C	32%	Lower Limit 1.33	Lower Limit 11.0
					Upper Limit 1.37	Upper Limit 11.5
Envirotech	800-577-5346	Non Chloride	NC 3000	25%	Lower Limit 1.30	Lower Limit 11.0
					Upper Limit 1.30	Upper Limit 11.0
Cryotech	800-346-7237	Calcium Magnesium Acetate	CMA	Recommended@ 25%	Lower Limit 1.14	Lower Limit 9.5
		Blended			Upper Limit 1.16	Upper Limit 10.0
Envirotech	800-577-5346	Magnesium Chloride	M-1000	27%	Lower Limit 1.25	Lower Limit 10.5

To: Maintenance Engineers/Superintendents
Field Testing and Sampling of Anti-Icing/Deicing Chemicals

					Upper Limit 1.33	Upper Limit 11.0
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Section 4

Chemical Application Guidelines

WSDOT ANTI-ICING CHEMICAL APPLICATION GUIDELINE

1. INTRODUCTION

This is a guide for WSDOT highway anti-icing operations for maintenance field personnel. Its purpose is to suggest maintenance actions for preventing the formation or development of packed and bonded snow or bonded ice during a variety of winter weather events. It is intended to complement the decision-making and management practices of a systematic anti-icing program so that roads can be efficiently maintained in the best possible condition.

The guidance is based upon the Federal Highway Administration's (FHWA) Manual of Practice for an Effective anti-icing Program and the National Cooperative Highway Research Program (NCHRP) 6-13. The Manual of Practice for an Effective anti-icing Program provides the results of four years of anti-icing field-testing conducted by 15 State highway agencies and supported by the Strategic Highway Research Program (SHRP) and the Federal Highway Administration (FHWA). This guide also uses information obtained from the National Cooperative Highway Research Program (NCHRP) 6-13. Both manuals provide application rates for Sodium Chloride (NaCl). This Guide has been prepared to show equivalent application rates for Calcium Chloride (CaCl_2), Magnesium Chloride (MgCl_2), and Calcium Magnesium Acetate (CMA)

2. GUIDANCE FOR ANTI-ICING OPERATIONS

Guidance for anti-icing operations is presented in Tables 1 to 6 for six distinctive winter weather events. The six events are:

1. Light Snow Storm
2. Light Snow Storm with Period(s) of Moderate or Heavy Snow
3. Moderate or Heavy Snow Storm
4. Frost or Black Ice
5. Freezing Rain Storm
6. Sleet Storm

The tables suggest the appropriate maintenance action to take during an initial or subsequent (follow-up) anti-icing operation for a given precipitation or icing event. Each action is defined for a range of pavement temperatures and an associated temperature trend. For some events the operation is dependent not only on the pavement temperature and trend, but also upon the pavement surface or the traffic condition at the time of the action. Most of the maintenance actions involve the application of a chemical in either a dry solid, liquid, or prewetted solid form. Application rates ("spread rates") are given for each chemical form where appropriate. These are suggested values and should be adjusted, if necessary to achieve increased effectiveness or efficiency, for local conditions. Application rates in volumetric units (gal/lane-mi)

are calculated from dry chemical rates. Comments and notes are given in each table where appropriate to further guide the maintenance field personnel in their anti-icing operations.

3. GLOSSARY OF TERMS

Black Ice. Popular term for a very thin coating of clear, bubble-free, homogeneous ice which forms on a pavement with a temperature at or slightly above 32°F when the temperature of the air in contact with the ground is below the freezing-point of water and small slightly super cooled water droplets deposit on the surface and coalesce (flow together) before freezing.

Freezing Rain. Super cooled droplets of liquid precipitation falling on a surface whose temperature is below or slightly above freezing, resulting in a hard, slick, generally thick coating of ice commonly called glaze or clear ice. Non-super cooled raindrops falling on a surface whose temperature is well below freezing will also result in glaze.

Frost. Also called hoarfrost. Ice crystals in the form of scales, needles, feathers or fans deposited on surfaces cooled by radiation or by other processes. The deposit may be composed of drops of dew frozen after deposition and of ice formed directly from water vapor at a temperature below 32°F (sublimation).

Light Snow. Snow falling at the rate of less than 1/2 in per hour; visibility is not affected adversely.

Liquid Chemical. A chemical solution; the volume of solution applied per lane mile is the chemical application rate used in this appendix.

Moderate or Heavy Snow. Snow falling at a rate of 1/2 in per hour or greater; visibility is significantly reduced.

Sleet. A mixture of rain and of snow, which has been partially melted by falling through an atmosphere with a temperature slightly above freezing.

Slush. Accumulation of snow, which lies on an impervious base and is saturated with water in excess of its freely drained capacity. It will not support any weight when stepped or driven on but will “squish” until the base support is reached.

Pre-wetting: The practice of applying liquid chemical to dry material before it is placed on the pavement

Dry Chemical Spread Rate. The chemical application rate. For solid applications it is simply the weight of the chemical applied per mile. For liquid applications it is the amount of liquid chemical applied per lane or mile.

Table 1. Weather event: LIGHT SNOW
Using a 32% concentration of Calcium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/lb-mi)	Maintenance Action	Chemical spread rate (gal/lb-mi)	
			Liquid CaCl ₂		Liquid CaCl ₂	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM... plow if needed
32°F, or below is imminent;	Dry	Apply liquid	15-35	Plow as needed; reapply liquid chemical when needed	15-35	*Application rates will depend on dilution potential
ALSO 20 to 32°F, remaining in range	Wet, slush, or light snow cover		20-40		20-40	
15 to 20°F, remaining in range	Dry, wet, slush, or light snow cover		30-65		30-65	* Application rates will depend on dilution potential
Below 15°F, steady or falling	Dry or light snow cover	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Washington State Department of Transportation Chemical Rate Guideline

Table 1. Weather event: LIGHT SNOW

Using a 25% concentration of CMA

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS			COMMENTS
	Pavement surface at time of Initial operation	Maintenance action	Chemical spread rate (gal/l _n -mi or lb/l _n -mi)		Maintenance action	Chemical spread rate (gal/l _n -mi or lb/l _n -mi)		N/R=Not Recommended
			Liquid CMA	Solid or prewet solid (lb)		Liquid CMA	Solid or prewet solid (lb)	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R		*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 30- 45 GPLM
32°F, or below is imminent;	Dry	Apply liquid or prewet solid chemical	30-45	75-125	Plow as needed; reapply liquid or solid chemical when needed	30-45	75-125	*Application rates will depend on dilution potential
ALSO 20 to 32°F, Remaining in range	Wet, slush, or light snow cover	Apply liquid or solid chemical	40-60	100-150		40-60	75-150	*Application rates will depend on dilution potential
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover	Apply prewet solid NaCl	N/R	200-240	Plow as needed; reapply solid NaCl when needed	N/R	200-240	*If sufficient moisture is present, solid chemical without prewetting can be applied *Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R		* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 1. Weather event: LIGHT SNOWUsing a 29% concentration of Magnesium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	
Above 32°F , Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM... plow if needed
32°F , or below is imminent;	Dry	Apply liquid	15-35	Plow as needed; reapply liquid chemical when needed	15-35	*Application rates will depend on dilution potential
<i>ALSO</i> 20 to 32°F , Remaining in range	Wet, slush, or light snow cover		20-40		20-40	
15 to 20°F , Remaining in range	Dry, wet, slush, or light snow cover		45-65		45-65	* Application rates will depend on dilution potential
Below 15°F , Steady or falling	Dry or light snow cover	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 1. Weather event: LIGHT SNOWUsing a 23% concentration of Sodium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS			COMMENTS
	Pavement surface at time of Initial operation	Maintenance action	Chemical spread rate (gal/l _n -mi or lb/l _n -mi)		Maintenance action	Chemical spread rate (gal/l _n -mi or lb/l _n -mi)		N/R=Not Recommended
			Liquid NaCl	Solid or prewet solid (lb)		Liquid NaCl	Solid or prewet solid (lb)	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R		*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 100 lb/lane-mi; plow if needed
32°F, or below is imminent;	Dry	Apply liquid or prewet solid chemical	40-50	75-125	Plow as needed; reapply liquid or solid chemical when needed	40-50	75-125	*Application rates will depend on dilution potential
ALSO 20 to 32°F, Remaining in range	Wet, slush, or light snow cover	Apply liquid or solid chemical	40-90	100-210		40-90	100-210	
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover	Apply prewet solid chemical	N/R	200-240	Plow as needed; reapply prewet solid chemical when needed	N/R	200-240	*If sufficient moisture is present, solid chemical without prewetting can be applied *Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R		* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 2. Weather event: LIGHT SNOW STORM WITH PERIOD (S) OF MODERATE OR HEAVY SNOWUsing a 32% concentration of Calcium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid CaCl ₂	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid CaCl ₂	
Above 32°F , Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM... plow if needed
32°F , or below is imminent;	Dry	Apply liquid	15-35	Plow as needed; reapply liquid chemical when needed	15-35	*Do not apply liquid chemical onto heavy snow accumulation or packed snow * Application rates will depend on dilution potential
<i>ALSO</i> 20 to 32°F , Remaining in range	Wet, slush, or light snow cover		20-40		20-40	
15 to 20°F , Remaining in range	Dry, wet, slush, or light snow cover		30-70		30-70	* Application rates will depend on dilution potential
Below 15°F , Steady or falling	Dry or light snow cover	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 2. Weather event: LIGHT SNOW STORM WITH PERIOD (S) OF MODERATE OR HEAVY SNOWUsing a 25% concentration of CMA

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS						COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/ln-mi or lb/ln-mi)		Maintenance Action	Chemical spread rate (gal/ln-mi or lb/ln-mi)					
			Liquid CMA	Solid or prewet Solid		Liquid CMA		Solid or prewet solid			
						Light snow	Heavier snow	Light snow	Heavier snow	N/R=Not Recommended	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R					* Monitor pavement temperature closely *Treat icy patches if needed with chemical at 20-40 GPLM; plow if needed
32°F, or below is imminent;	Dry	Apply liquid or prewet solid chemical	35-60	150-200	Plow as needed; reapply liquid or solid chemical when needed	40-60	N/R	150-200	N/R		*Do not apply liquid chemical onto heavy snow accumulation or packed snow * Application rates will depend on dilution potential
ALSO 25 to 32°F, Remaining in range	Wet, slush, or light snow cover	Apply liquid or solid chemical	40-70	150-200		40-70	N/R	150-200	N/R		
15 to 25°F, Remaining in range	Dry, wet, slush, or light snow cover	Apply prewet solid NaCl	N/R		Plow as needed; reapply prewet solid chemical when needed	N/R					
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R				* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction	

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 2. Weather event: LIGHT SNOW STORM WITH PERIOD (S) OF MODERATE OR HEAVY SNOWUsing a 29% concentration of Magnesium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM... plow if needed
32°F, or below is imminent;	Dry	Apply liquid	15-35	Plow as needed; reapply liquid chemical when needed	15-35	
ALSO 20 to 32°F, Remaining in range	Wet, slush, or light snow cover		20-40		20-40	*Application rates will depend on dilution potential
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover		45-70		45-70	* Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

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Table 2. Weather event: LIGHT SNOW STORM WITH PERIOD (S) OF MODERATE OR HEAVY SNOWUsing a 23% concentration of Sodium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS						COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/lb-mi or lb/lb-mi)		Maintenance Action	Chemical spread rate (gal/lb-mi or lb/lb-mi)					
			Liquid NaCl	Solid or prewet Solid		Liquid NaCl		Solid or prewet solid			
						Light snow	Heavier snow	Light snow	Heavier snow		
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R				*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 40-65 GPLM; plow if needed	
32°F, or below is imminent;	Dry	Apply liquid or prewet solid chemical	40-65	75-150	Plow as needed; reapply liquid or solid chemical when needed	40-50	50-65	75-125	150-200	*Do not apply liquid chemical onto heavy snow accumulation or packed snow * Application rates will depend on dilution potential	
ALSO 25 to 32°F, Remaining in range	Wet, slush, or light snow cover	Apply liquid or solid chemical	65-90	175-200		65-80	80-90	175-185	190-200		
15 to 25°F, Remaining in range	Dry, wet, slush, or light snow cover	Apply prewet solid chemical	N/R	200-230	Plow as needed; reapply prewet solid chemical when needed	N/R		200-230	200-250	* If sufficient moisture is present, solid chemical without prewetting can be applied * Application rates will depend on dilution potential	
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R				* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction	

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 3. Weather event: MODERATE OR HEAVY SNOW STORMUsing a 32% concentration of Calcium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/lb-mi) Liquid CaCl ₂	Maintenance Action	Chemical spread rate (gal/lb-mi) Liquid CaCl ₂	
Above 32°F , Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM plow if needed
32°F , or below is imminent;	Dry	Apply prewet solid NaCl	N/R	Plow accumulation and reapply prewet solid chemical as needed	N/R	* If sufficient moisture is present, solid chemical without prewetting can be applied * Do not apply liquid chemical onto heavy snow accumulation or packed snow
<i>ALSO</i> 20 to 32°F , Remaining in range	Wet, slush, or light snow cover		N/R		N/R	
15 to 20°F , Remaining in range	Dry, wet, slush, or light snow cover		N/R		N/R	
Below 15°F , Steady or falling	Dry or light snow cover	Plow accumulation as needed	N/R	Plow accumulation as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 3. Weather event: *MODERATE OR HEAVY SNOW STORM*Using a 25% concentration of CMA

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS			COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/lb-mi or lb/lb-mi)		Maintenance Action	Chemical spread rate (gal/lb-mi or lb/lb-mi)		
			Liquid CMA	Solid or prewet Solid		Liquid CMA	Solid or prewet solid	N/R=Not Recommended
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R		*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 35-45 GPLM; plow if needed
32°F, or below is imminent;	Dry	Apply liquid or prewet solid chemical	40-70	150-200	Plow as needed; reapply liquid or solid chemical as needed	40-70	150-200	*Do not apply liquid chemical onto heavy snow accumulation or packed snow *Application rates will depend on dilution potential * If sufficient moisture is present, solid chemical without prewetting can be applied
ALSO 25 to 32°F, Remaining in range	Wet, slush, or light snow cover	Apply prewet solid NaCl	N/R		Plow accumulation and reapply prewet solid chemical as needed	N/R		
15 to 25°F, Remaining in range	Dry, wet, slush, or light snow cover		N/R			N/R		
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R		* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 3. Weather event: *MODERATE OR HEAVY SNOW STORM*Using a 29% concentration of *Magnesium Chloride*

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM plow if needed
32°F, or below is imminent;	Dry	Apply prewet solid NaCl	N/R	Plow accumulation and reapply prewet solid chemical as needed	N/R	* If sufficient moisture is present, solid chemical without prewetting can be applied * Do not apply liquid chemical onto heavy snow accumulation or packed snow
ALSO 20 to 32°F, Remaining in range	Wet, slush, or light snow cover		N/R		N/R	
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover		N/R		N/R	
Below 15°F, Steady or falling	Dry or light snow cover	Plow accumulation as needed	N/R	Plow accumulation as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 3. Weather event: *MODERATE OR HEAVY SNOW STORM*Using a 23% concentration of *Sodium Chloride*

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS			COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/ln-mi or lb/ln-mi)		Maintenance Action	Chemical spread rate (gal/ln-mi or lb/ln-mi)		N/R=Not Recommended
			Liquid NaCl	Solid or prewet Solid		Liquid NaCl	Solid or prewet solid	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R		*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 40-65 GPLM; plow if needed
32°F, or below is imminent;	Dry	Apply liquid or prewet solid chemical	40-65	75-150	Plow accumulation and reapply liquid or prewet solid chemical as needed	50-65	150-200	*Do not apply liquid chemical onto heavy snow accumulation or packed snow * Application rates will depend on dilution potential
ALSO 25 to 32°F, Remaining in range	Wet, slush, or light snow cover	Apply solid chemical	N/R	175-200	Plow accumulation and reapply prewet solid chemical as needed	80-90	190-200	
15 to 25°F, Remaining in range	Dry, wet, slush, or light snow cover	Apply prewet solid chemical	N/R	200-230	Plow as needed; reapply prewet solid chemical when needed	N/R	200-250	* If sufficient moisture is present, solid chemical without prewetting can be applied * Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R		* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 4. Weather event: FROST OR BLACK ICEUsing a 32% concentration of Calcium Chloride

PAVEMENT TEMPERATURE RANGE, TREND, AND RELATION TO DEW POINT	TRAFFIC CONDITION	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
		Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid CaCl ₂	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid CaCl ₂	N/R=Not Recommended
32°F, Steady or rising	Any level	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely; begin treatment if temperature starts to fall to 32°F or below and is at or below dew point
28 to 32°F, Remaining in range or falling 32°F or below, <i>and</i> equal to or below dew point	Traffic rate less than 100 vehicles per hour	Apply liquid chemical	10-25	Reapply liquid chemical as needed	10-25	* Application rates will depend on dilution potential
	Traffic rate greater than 100 vehicles per hour		20-35		20-35	
15 to 28°F, Remaining in range, <i>and</i> equal to or below dew point	Any level		20-40		25-40	* Application rates will depend on dilution potential
Below 15°F, Steady or falling	Any level	Apply abrasives	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 4. Weather event: FROST OR BLACK ICEUsing a 25% concentration of CMA

PAVEMENT TEMPERATURE RANGE, TREND, AND RELATION TO DEW POINT	TRAFFIC CONDITION	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
		Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid CMA	Maintenance Action	Chemical spread rate (gal/ln-mi) Liquid CMA	N/R=Not Recommended
32°F, Steady or rising	Any level	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely; begin treatment if temperature starts to fall to 32°F or below and is at or below dew point
28 to 32°F, Remaining in range or falling 32°F or below, <i>and</i> equal to or below dew point	Traffic rate less than 100 vehicles per h	Apply liquid chemical	25-35	Reapply liquid chemical as needed	25-35	* Application rates will depend on dilution potential
	Traffic rate greater than 100 vehicles per h		30-45		25-40	
20 to 28°F, Remaining in range, <i>and</i> equal to or below dewpoint	Any level		35-50		35-50	* Application rates will depend on dilution potential
15 to 20°F, Remaining in range, <i>and</i> equal to or below dewpoint	Any level	Apply prewet solid NaCl	N/R	Reapply prewet solid chemical when needed	N/R	
Below 15°F, Steady or falling	Any level	Apply abrasives	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 4. Weather event: FROST OR BLACK ICEUsing a 29% concentration of Magnesium Chloride

PAVEMENT TEMPERATURE RANGE, TREND, AND RELATION TO DEW POINT	TRAFFIC CONDITION	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
		Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	N/R=Not Recommended
32°F, Steady or rising	Any level	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely; begin treatment if temperature starts to fall to 32°F or below and is at or below dew point
28 to 32°F, Remaining in range or falling 32°F or below, <i>and</i> equal to or below dew point	Traffic rate less than 100 vehicles per hour	Apply liquid chemical	15-35	Reapply liquid chemical as needed	15-30	* Application rates will depend on dilution potential
	Traffic rate greater than 100 vehicles per hour		20-35		20-35	
15 to 28°F, Remaining in range, <i>and</i> equal to or below dew point	Any level		25-40		25-40	* Application rates will depend on dilution potential
Below 15°F, Steady or falling		Apply abrasives as needed	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 4. Weather event: FROST OR BLACK ICEUsing a 23% concentration of *Sodium Chloride*

PAVEMENT TEMPERATURE RANGE, TREND, AND RELATION TO DEW POINT	TRAFFIC CONDITION	INITIAL OPERATION			SUBSEQUENT OPERATIONS			COMMENTS
		Maintenance Action	Chemical spread rate (gal/l _n -mi or Lb/l _n -mi)		Maintenance Action	Chemical spread rate (gal/l _n -mi or lb/l _n -mi)		N/R=Not Recommended
			Liquid NaCl	Solid or prewet solid		Liquid NaCl	Solid or prewet solid	
32°F, Steady or rising	Any level	None, see comments	N/R		None, see comments	N/R		*Monitor pavement temperature closely; begin treatment if temperature starts to fall to 32°F or below and is at or below dew point
28 to 32°F, Remaining in range or falling 32°F or below, <i>and</i> equal to or below dew point	Traffic rate less than 100 vehicles per h	Apply liquid or prewet solid chemical	45-60	100-130	Reapply liquid or prewet solid chemical when needed	45-60	100-130	* Application rates will depend on dilution potential
	Traffic rate greater than 100 vehicles per h		45-75	100-130		45-75	100-130	
	20 to 28°F, Remaining in range, <i>and</i> equal to or below dewpoint		Any level	65-80		165-200	65-80	165-200
15 to 20°F, Remaining in range, <i>and</i> equal to or below dewpoint	Apply prewet solid chemical	N/R		175-225	Reapply prewet solid chemical when needed	N/R	175-225	
Below 15°F, Steady or falling	Apply abrasives	N/R		Apply abrasives as needed	N/R		* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction	

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 5. Weather event: FREEZING RAINSTORMUsing a 29% concentration of Magnesium ChlorideUsing a 32% concentration of Calcium ChlorideUsing a 25% concentration of CMA

CHEMICAL APPLICATIONS: It is possible to use these chemicals during this event but is not recommended. The application rate needed would be cost prohibitive and the potential for dilution is high. It is recommended to use a solid chemical application or abrasives.

Using a 23% concentration of Sodium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Chemical spread rate (lb/l _n -mi) NaCl	Maintenance Action	Chemical spread rate (lb/l _n -mi) NaCl	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	* Monitor pavement temperature closely *Treat icy patches if needed with prewetted solid chemical at 100--150 lb/lane-mi
32°F, or below is imminent	Apply solid chemical	100-200	Reapply solid chemical as needed	100-200	*Monitor pavement temperature and precipitation closely * Application rates will depend on dilution potential
20 to 32°F, Remaining in range		200-300		200-300	
15 to 20°F, Remaining in range		250-400		250-400	
Below 15°F, Steady or falling	Apply abrasives	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 6. Weather event: SLEET STORMUsing a 32% concentration of Calcium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Liquid CaCl ₂	Maintenance Action	Liquid CaCl ₂	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	Go to Sodium Chloride Chart
32°F, or below is imminent	Apply solid NaCl	N/R	Plow accumulation and reapply prewet solid chemical as needed	N/R	
28 to 32°F, Remaining in range					
15 to 28°F, Remaining in range					
Below 15°F, Steady or falling	Plow as needed	N/R	Plow as needed	N/R	

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 6. Weather event: SLEET STORMUsing a 25% concentration of CMA

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Chemical spread rate, lb/lane-mi\ CMA	Maintenance Action	Chemical spread rate, lb/lane-mi CMA	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely for drops toward 32°F and below *Treat icy patches if needed with solid chemical at 125 lb/lane-mi
32°F, or below is imminent	Apply solid chemical	150-200	Plow accumulation and reapply prewet solid chemical as needed	150-200	*Monitor pavement temperature and precipitation closely * Application rates will depend on dilution potential
28 to 32°F, Remaining in range	Apply solid NaCl	N/R		N/R	Go to Sodium Chloride Chart
15 to 28°F, Remaining in range		N/R		N/R	
Below 15°F, Steady or falling	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 6. Weather event: SLEET STORMUsing a 29% concentration of Magnesium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Liquid MgCl ₂	Maintenance Action	Liquid MgCl ₂	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	Go to Sodium Chloride Chart
32°F, or below is imminent	Apply solid NaCl	N/R	Plow accumulation and reapply prewet solid chemical as needed	N/R	
28 to 32°F, Remaining in range					
15 to 28°F, Remaining in range					
Below 15°F, Steady or falling	Plow as needed	N/R	Plow as needed	N/R	

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 6. Weather event: SLEET STORMUsing a 23% concentration of Sodium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Chemical spread rate, lb/lane-mi NaCl	Maintenance Action	Chemical spread rate, lb/lane-mi NaCl	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	* Monitor pavement temperature closely *Treat icy patches if needed with prewetted solid chemical at 100-150 lb/lane-mi
32°F, or below is imminent	Apply solid chemical	125	Plow accumulation and reapply prewet solid chemical as needed	125	*Monitor pavement temperature and precipitation closely * Application rates will depend on dilution potential
28 to 32°F, Remaining in range		125-325		125-325	
15 to 28°F, Remaining in range		250-400		250-400	
Below 15°F, Steady or falling	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.